PUBLICATIONS

OF

FIELD MUSEUM OF NATURAL HISTORY

GEOLOGICAL SERIES

VOLUMES 8 AND 9

CHICAGO, U.S.A.
1940–1945

PRINTED IN THE UNITED STATES OF AMERICA
BY FIELD MUSEUM PRESS

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GEOLOGICAL SERIES
OF
FIELD MUSEUM OF NATURAL HISTORY

Volume 8 | CHICAGO, JUNE 29, 1940 | No. 1

A NEW TURTLE OF THE GENUS PODOCNEMIS FROM THE CRETACEOUS OF ARKANSAS

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The turtles of the genus *Podocnemis*, with seven living species in northern South America and one in Madagascar, afford a classic example of discontinuous distribution in the southern hemisphere, paralleled to a degree by other South American relations among Madagascan reptiles (notably in iguanid lizards and boid snakes). I have long been an adherent of the Matthewsian explanation of such distributions as due to radiating dispersal from Holarctic centers, and I cited the case of *Podocnemis* in this connection (1923, p. 9, map 3) to amplify Matthew's remarks on the pleurodiran turtles (1915, p. 284), since the well-known fossil forms of the Egyptian and English Eocene cast some light on the dispersal of the group. The accompanying map (fig. 1) shows the distribution of the genus, fossil and living, as now known.

In describing an Eocene species of *Podocnemis* from Peru, in 1931, I called attention to the necessary corollary of our hypothesis, that *Podocnemis* must have been also North American. Discounting the Cretaceous *Podocnemis harrisi* of São Paulo, Brazil, as based on fragments inadequate for certain generic identification, but with the certainly Eocene age of the Peruvian form in mind, I concluded that the dispersal of the genus must have been Mesozoic and ventured to predict the discovery of North American Mesozoic fossil forms of this genus (1931, p. 254).

This prediction is now fulfilled by the discovery of a nearly complete shell of a *Podocnemis* in the Cretaceous of Arkansas by Mr. Charles M. Barber, of Hot Springs (acquired by Field Museum by purchase). Mr. Barber, an enthusiastic collector of fossils, and a former member of the staff of our Department of Zoology, has presented numerous Arkansan specimens of fossil turtles to Field Museum, mostly from the Marlbrook Marl, a formation of the

Gulf Series corresponding in age to the Pierre Cretaceous. In the pursuit of his collecting in the summer of 1938, he extended his search to the series of more or less isolated areas of the much earlier Brownstown Marl (of Niobraran age), which extends across Arkansas from the Oklahoma line toward Arkadelphia. In deposits of this formation, in a deep gully crossing a field of the E. L. Presley Farm, near Delight, in Pike County, Mr. Barber discovered a large

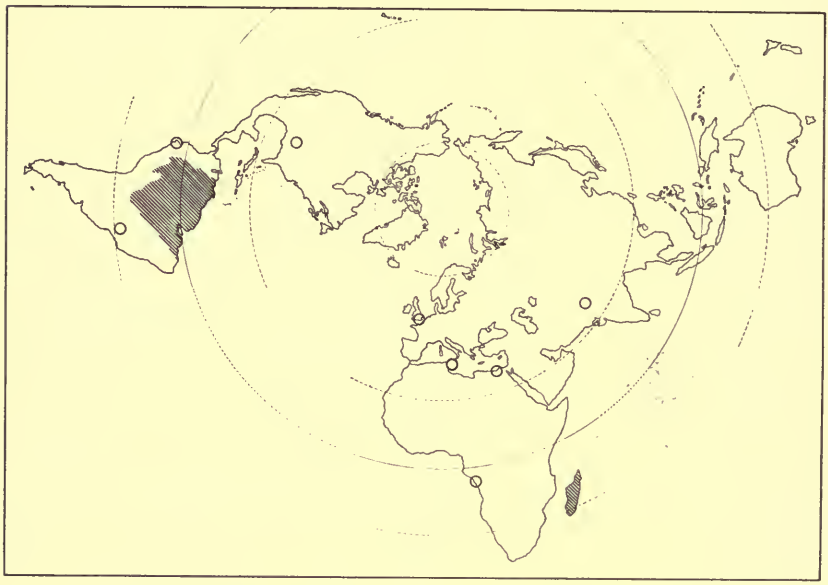

FIG. 1. Map showing the distribution of the genus *Podocnemis*, the range of the living forms cross-lined, the fossil localities shown by circles.

number of loosely associated fragments of what proved to be a large pleurodiran turtle. These, when matched, formed about three-fourths of a carapace and plastron of a turtle some twenty-six inches long and nearly as wide. This specimen has been turned over to me for study and report by Mr. Elmer S. Riggs, Curator of Paleontology. The help given by Mr. James H. Quinn, Assistant in Paleontology, has been invaluable in working out the course of the sutures between the bones and the scars of the horny plates. The zoogeographic implications have been discussed with my valued colleague, Mr. Bryan Patterson, also of the Department of Geology in Field Museum.

Mr. Barber continued to take an active interest in his best "find" in the Arkansas Cretaceous, and, by visiting the same lo-

cality on successive occasions after heavy rains, found numerous additional pieces of shell of the same turtle. These were forwarded to Field Museum while Mr. Quinn, in the Museum's paleontological laboratory, was engaged in assembling this most extraordinary of jigsaw puzzles. Piece after piece of shell was fitted into place; it seemed a peculiar triumph to fill gaps in the shell with pieces found more than a year after the original discovery. Mr. Stanley Kuzeck aided in fitting together numerous fragments of the much crushed lateral peripherals that enter the bridge, and in the final assembly of the shell under Mr. Quinn's direction.

A fragment of the plastron of a larger specimen was found near Delight; two peripherals of a smaller one, and a large neural almost certainly of the same species, were discovered in a gully on the John Humphreys farm, about half a mile southwest of the type locality. These were presented to Field Museum by Mr. Barber.

Mr. Barber has been extremely helpful in the preparation of the present paper by assembling the available information on the stratigraphic relations of the Brownstown Marl. At his instance, Professor Gayle Scott, of Texas Christian University, has kindly supplied generic identifications of fragments of cephalopods found associated with our fossil turtle. The significance of the present specimen for the understanding of the past and present distribution of the genus *Podocnemis* will be discussed below.

Order **Testudinata**
Suborder **Pleurodira**
Family **Pelomedusidae**[1]
Podocnemis barberi,[2] sp. nov.

Holotype.—F.M. No. P26055, a nearly complete carapace and plastron. Collected by Charles M. Barber.

Paratypes.—A first neural and fragment of hyoplastron of specimens larger than the type, Nos. P26058 and P26060; and a second peripheral, with fragments of the adjoining first, of a much smaller specimen, No. P26059. Collected and presented by Charles M. Barber.

[1] The family name Pelomedusidae is used in an inclusive sense; the family Bothremydidae, known only from fossil skulls, obviously cannot be fitted into any comprehensive revision. *Taphrosphys*, with skull unknown, is placed in the Bothremydidae by Hay; it may clearly be allied to *Podocnemis*. I have followed the family arrangement of Boulenger, leaving a revision of the families of the suborder Pleurodira for the future.

[2] Named for Mr. Charles M. Barber, of Hot Springs, Arkansas.

Horizon and type locality.—Brownstown Marl, Gulf Series, Upper Cretaceous, in a gully on the SW. ¼ of NE. ¼ of Section 29, Township 8 S., Range 23 W., E. L. Presley Farm, near Delight, Pike County, Arkansas. See Dane, 1929, p. 46, for an account of this formation in Arkansas.

FIG. 2. Dorsal view of carapace of *Podocnemis barberi*, type. × 0.185.

Diagnosis.—A large pleurodire, with xiphiplastral scars well developed; small mesoplastra on the bridge; shell very broad; a well-defined anterior notch in the carapace; nuchal with sharply angulate sides; six neurals, the sixth, seventh, and eighth costals meeting between the sixth neural and the large subtriangular pygal.

Differs from the Cretaceous *Podocnemis brasiliensis* in the presence of a distinct anterior notch of the carapace, the angulate sides of the nuchal bone, and the much broader anterior lobe of the plastron.

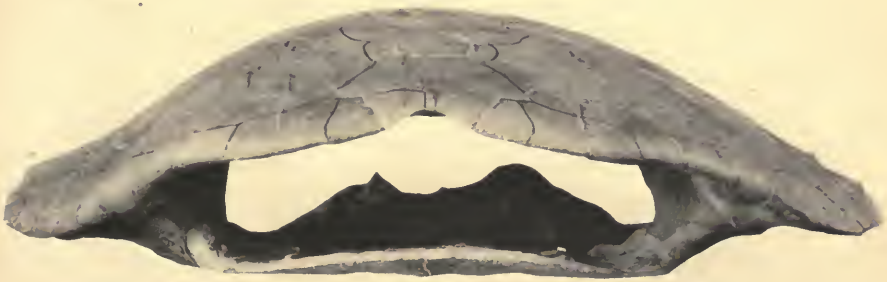

FIG. 3. Anterior view of *Podocnemis barberi*, type. × 0.185.

Description of type.—The carapace is broadly rounded, with no trace of median keel, with a well-defined anterior notch, and with the postero-lateral borders slightly incurved, producing an obtusely pointed posterior end. Its greatest width is a little behind mid-

FIG. 4. Lateral view of shell of *Podocnemis barberi*, type. × 0.18.

length. The relatively flat shape is shown in the anterior and lateral profile views. The plastron has a broad smoothly rounded anterior lobe, more than twice as broad as long, and shorter than the bridge. The posterior lobe is also wider than long, with a broad subtriangular notch, and slightly curved outer borders of hypoplastra and xiphiplastra, producing a slight notch at their suture.

The carapace is composed of nuchal, eleven pairs of peripherals, pygal, suprapygal, eight pairs of costals, and six neurals. The nuchal has a most characteristic shape, sharply notched on the lateral borders where the horny marginal scar crosses. The first neural is

six-sided, the lateral sides subequal, while in the second to fifth neurals the antero-lateral side is about a third the length of the postero-lateral. The sixth neural is five-sided. The very large anterior costals are succeeded by the roughly oblong second to eighth, the fifth being next widest. The sixth costals meet on the mid-line behind the sixth neural, as do the seventh and eighth pairs. The suprapygal is five-sided. The anterior peripherals have rounded borders. The third to eighth are involved in the bridge. The ninth, tenth, and eleventh pairs, and the pygal come to a sharp marginal edge. Superficial sculpture of the elements of the carapace is slight.

The scars of the buttresses on the interior of the first and fifth costals are large, and evidently interrupted by a broad canal on each side. A well-defined iliac scar is present on the seventh and eighth costals.

The plastron is composed of the normal eleven elements. The small rounded mesoplastra are situated on the bridge, their inner angles about in line with the outer borders of the lobes of the plastron produced across the bridge. The median epiplastral suture measures 35 mm., the hyoplastral 120, the hypoplastral 126, and the xiphiplastral 153. The strong pubic and ischial scars of the xiphiplastra are somewhat worn, but an inward extension of the ischial scars nearly to the mid-line of the xiphiplastra is evident. The ischial scars are well within the borders of the xiphiplastra, corresponding to their normal situation in *Podocnemis*.

The scars of the horny plates of the plastron are not discernible. The scars can be followed on the carapace, and are shown in black on the plate. There are twelve pairs of marginals, with no nuchal. Of the five vertebrals, the first is somewhat hourglass-shaped, the last very large. There are four very large costals on each side.

Disease scars.—In addition to the two rounded holes that pierce the carapace (evident in the figure), there is a shallow pit, probably of similar origin, on the middle of the seventh left costal. These holes and the pit may well be due to some external parasite, or to disease. Somewhat similar pits are to be seen in a large specimen of *Pelusios sinuatus* in Field Museum's collections.

MEASUREMENTS OF TYPE

(All measurements made with calipers)

	MM.
Length of carapace on mid-line	630.0
Depth of anterior notch	20.0
Total length of carapace	650.0
Greatest breadth of carapace	604.0
Length of nuchal	86.3

Anterior width of nuchal	56.0
Greatest width of nuchal	135.4
Length of first neural	64.6
Length of second neural	57.2
Length of third neural	57.0
Length of fourth neural	48.0
Length of fifth neural	48.5
Length of sixth neural	39.0
Length of suprapygal	78.5
Length of pygal	91.6
Length of plastron on mid-line	497.0
Depth of xiphiplastral notch	42.0
Total length of plastron	539.0
Width of plastron to outer angles of mesoplastra	460.0
Width of anterior lobe	314.0
Length of anterior lobe	120.0
Width of posterior lobe	231.0
Length of posterior lobe (on mid-line)	192.0
Width of bridge (right and left)	188, 191
Length of entoplastron	66.7
Width of entoplastron	88.2
Suture between epiplastra	35 0
Suture between hyoplastra	120.0
Suture between hypoplastra	125.7
Suture between xiphiplastra	153.0
Width of left mesoplastron	83.3
Length of left mesoplastron	65.5

Description of paratypes.—A large fragment (No. P26058) of a right hyoplastron indicates a specimen larger than the type; this comes from near the Presley home about half a mile southeast of Delight. No. P26059 is a first left peripheral of a much smaller specimen, and this, with a neural of a much larger individual (No. P26060) was found on the John Humphreys farm about two and a half miles southwest of Delight, and about a mile from the type locality. The large neural is somewhat worn, but may best be interpreted as a first neural; its length is 82.8 mm., which corresponds to an estimated total length of carapace of 830. Even this large size is but little larger than the maximum record for the living *Podocnemis expansa* of the Amazon. Our specimens appear to represent much the largest fossil form thus far known.

Stratigraphic position.—The fossils associated with the turtle here described were a worn shark's tooth, various fish vertebrae and jaws, and fragments of cephalopods. The latter were identified by Professor Gayle Scott as representing the genera *Placenticeras*, *Baculites*, and probably *Bostryoceras*.

The exposure of Brownstown Marl near Delight is shown by Dane (1929, pl. 1) as an extensive, rather isolated area of this formation. Mr. Barber believes that the deposits in which the turtles were found belong to the lowermost stage of the Brownstown.

Stephenson (1937a, p. 144) places this formation as equivalent to the Gober Tongue of the Austin Chalk (of Texas)—older, therefore, than the Taylor Marl. The Brownstown Marl is to be regarded as essentially of Niobraran age.

FIG. 5. Plastral view of *Podocnemis barberi*, type. × 0.185.

The deposits are plainly marine, though the sea in which they originated was doubtless shallow. There is no especial reason to believe that the fossil turtle remains could have been derived from a fresh-water source, as the Brownstown Marl seems to represent a return to conditions more distinctly marine after the shallow water sediments, containing lignite, of the upper stages of the

Tokio formation. The genuinely marine origin of *Podocnemis barberi* is supported by the finding of the remains of three individuals, and by the excellent preservation of the type.

Discussion of the genus.—The species currently referred to the genus *Podocnemis* are the following:

RECENT *

cayennensis Schweigger, *dumeriliana* Schweigger, *expansa* Schweigger, *lewyana* Duméril, *sextuberculata* Cornalia, *unifilis* Troschel, *vogli* Müller — Northern South America

madagascariensis Grandidier — Madagascar

MIOCENE

aegyptiaca Andrews, *bramlyi* Fourtau — Egypt

lata Ristori — Malta

OLIGOCENE

dehmi Bergounioux — Germany

EOCENE

bowerbanki Owen, *delabechei* Owen — England

indica Lydekker — India

antiqua Andrews, *stromeri* Reinach, *podocnemoides* Reinach — Egypt

olssoni Schmidt — Peru

PALEOCENE

congolensis Dollo — Lower Congo

UPPER CRETACEOUS

harrisi Pacheco, *brasiliensis* Staesche — São Paulo

barberi sp. nov. — Arkansas

* I have followed Müller (1935, p. 108) for the recent list.

Stereogenys podocnemoides lacks the generic character of *Stereogenys*, the separation of the nuchal from the first neural by a contact of the first costals on the mid-line; this species has accordingly been included in the list above. Dollo's *Bantuchelys congolensis* (originally described as *Podocnemis congolensis*) is known only from fragments of carapace and plastron, and should be retained in *Podocnemis* until it is better known.

Bergounioux (1932, p. 542) mentions an undescribed species from the Eocene of Belgium, and gives a list of the fossil and living species known to him. Certain shell fragments from the Eocene of Nigeria have been referred to *Podocnemis* by Swinton, but this reference has not been available.

The New Mexican Paleocene or Cretaceous *Naiadochelys ingravata* (Hay, 1908, p. 125, fig. 133) is known only from a fragment of xiphiplastron, with a strong ischial scar extending to the midline. This fragment may represent a *Podocnemis;* but it is best to omit *ingravata* from the list until the form becomes better known.[1]

The first *Podocnemis* to be described from the Cretaceous was *P. harrisi* of the Bauru formation of São Paulo, Brazil (Pacheco, 1913, p. 37, pls. 3 and 4). This reference was unknown to me when I discussed the genus in 1923. In speculations based on my species *olssoni* of the Peruvian Eocene, in 1931, I did not think *harrisi* sufficiently known to regard its allocation as certain. The discovery of much more complete remains of a similar turtle from the same beds confirms Pacheco's generic identification, though Staesche, in describing the new material, has thought it best to establish a new form, *Podocnemis brasiliensis* (Staesche, 1937, p. 291, figs. 1 and 2).

No one appears to have drawn up an adequate account of the osteology of the living species of *Podocnemis.* The shell of *Podocnemis sextuberculata,* figured by Boulenger (1889, p. 201, fig. 51) has seven neurals. *P. expansa,* a shell of which has been at hand during the preparation and study of our Arkansas specimen, has six neurals; and this seems also to be the case in *P. madagascariensis.* A comparative study of the several living forms should be made for use in connection with the further discoveries of fossils of this genus that are obviously to be expected.

The genus *Taphrosphys* of the Eocene[2] Greensands of New Jersey is allied to *Podocnemis* by the similar position of the mesoplastra. The character that best distinguishes *Taphrosphys* from *Podocnemis* (including *P. barberi*) seems to be the small size of the ischial scar and its position at the posterior border of the xiphiplastron. In *Podocnemis* the ischium is set well within the border of the xiphiplastron and extends to meet its fellow (*P. expansa*), or at least nearly to the median suture, as in *Podocnemis barberi.*

The origin of the genus *Podocnemis* is still obscure.

Zoogeography.—The existing species in South America and Madagascar are strictly confined to fresh waters. This may have

[1] Mr. Barber points out that the geological horizon of the fragment of turtle shell on which *Naiadochelys* was based can scarcely be regarded as certainly known. The specimen was brought by an Indian to Professor F. W. Putnam, who relayed it to Dr. Hay.

[2] These deposits, long regarded as Cretaceous, are now proved to be of Eocene age (Cooke and Stephenson, 1928, and Stephenson, 1937).

been the case also with the Tertiary forms, but the deposits in which these turtles have been found in both England and Egypt are fluvio-marine or estuarine rather than strictly continental. The Miocene *P. lata* from Malta is from a marly limestone, and is associated with fossil *Trionyx* and *Tomistoma*, both essentially fresh-water types. Previous zoogeographic speculations have involved the assumption that the dispersal of the genus must have been via fresh waters and hence via land bridges.

The discovery of *Podocnemis barberi*, from marine sediments, accordingly throws a clear but somewhat unexpected light on the means by which the very wide distribution of this type in the Eocene estuarine deposits may have come about. There is no structural modification indicating any great degree of adjustment to the marine habitat, and this, with the absence of *Podocnemis* from other marine Cretaceous sediments, suggests that this entry into the sea was of short duration. It is none the less clear that even a relatively brief marine career would be sufficient to account for dispersal to the coasts of Europe, west Africa, and, via the Tethys sea, to North Africa and India. It is thus unnecessary to suppose that *Podocnemis* spread via fresh waters from the New to the Old World (or vice versa) and unnecessary to speculate as to land connections, by means of which these turtles might have attained their existing distribution, whether trans-Atlantic or trans-Alaskan.

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